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SECURING NUCLEAR FUEL CYCLE
WHEN EMBRACING GLOBAL NUCLEAR RENAISSANCE

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OUTLINES

- **Global Nuclear Renaissance — An Inevitable Trend**
- **China's Action towards Global Nuclear Renaissance**
- **Strengthening International Cooperation on Nuclear Fuel Cycle**



Global Nuclear Renaissance —

An Inevitable Trend



Global Nuclear Renaissance — An Inevitable Trend

World population today : **6.6 billion**

No access to electricity: **2.2**

Limited access to electricity: **2.2**

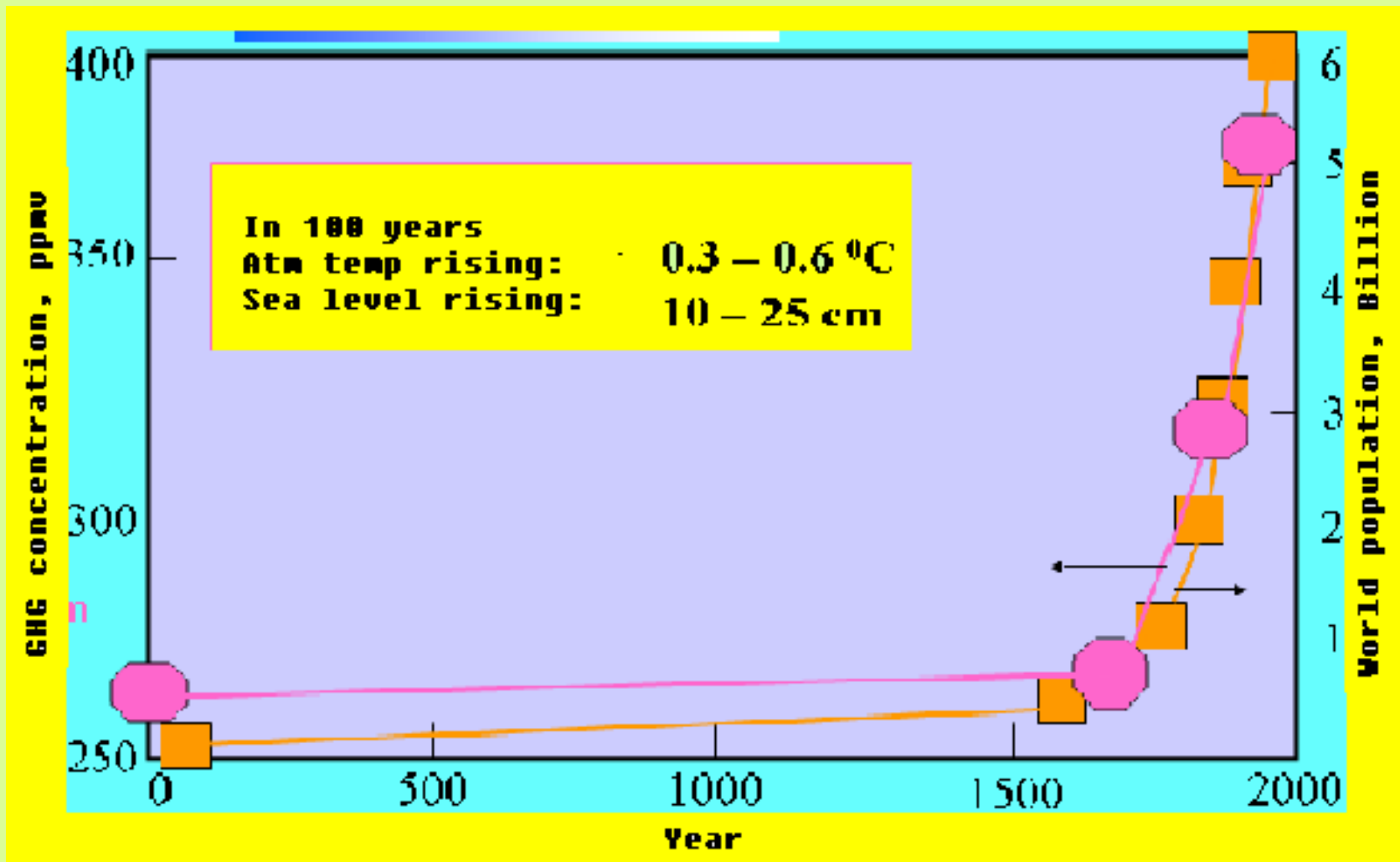
Without safe water: **1.0**

Lack of sanitation: **2.4**

Global energy demands need to be doubled by 2050





Global Nuclear Renaissance — An Inevitable Trend



Increase of world population and GHGs with time

Global Nuclear Renaissance — An Inevitable Trend

The challenges of the world population and environmental problems calls for the development of Low emission energy:

-  **Renewables**
-  **Nuclear energy**

Global Nuclear Renaissance — An Inevitable Trend

The non-hydro renewable resources

- are clean energy with very little emission of GHGs.
- deserve strong support and need to be developed.

Some limitations of the non-hydro renewables:

● Low Energy density

<u>Plant type</u>	<u>Area occupied by a 1 GWe plant</u>
Coal-fired or NPP :	~ few km ²
Solar or wind power:	~100 km ²

● Intermittent supply of power

<u>Plant type</u>	<u>Availability</u>
Nuclear power	~90%
Wind power	≤30%
Solar power	≤15%



Global Nuclear Renaissance — An Inevitable Trend

New renewables, a supplement, not a base-load

It is expected that the global share of non-hydro renewables could reach:

~5% by 2020

~10% by 2050



Global Nuclear Renaissance — An Inevitable Trend

Nuclear energy

- a **clean energy** with very **low emission** of GHGs
- the **only proven option** to replace the fossil energy as a **base load**
- **conclusion:**
our world cannot meet its **expanding energy needs** **cleanly** without a **sharp expansion** of nuclear energy



Global Nuclear Renaissance — An Inevitable Trend

Nuclear energy

- **The major countries (such as US, Russia, Japan, Korea, India, China) have a strong commitment to nuclear energy**
- **Nations - such as Argentina, Brazil, Canada, Finland, South Africa, Ukraine - are increasing nuclear power**
- **Countries such as Vietnam, Indonesia, Jordan and Egypt are considering this option.**

The global renaissance of nuclear energy is round here

China's Action towards Global Nuclear Renaissance

China's Action towards Global Nuclear Renaissance

China's energy demand expectation

	2008	2020
Total energy (Gtce)	1.5	3.0
Electricity (GWe)	790	1250

China's per capita energy consumption today is only 84% of the world average

China's Action towards Global Nuclear Renaissance

A severe problem of China's energy structure:

Energy source	Capacity share (%)
Fossil	77.5
Hydro	20.4
Nuclear	1.3
New renewables	0.8

Coal-fired power constitutes 77%!

Causing serious environmental problem!

China's Action towards Global Nuclear Renaissance

Measures to lower the share of coal-fired power

- Developing energy-saving technologies
- Expanding hydropower
- Encouraging non-hydro renewables
- Speeding up **nuclear power**

China's Action towards Global Nuclear Renaissance

China's nuclear power development expectation

Year	2008	2020	2030
Installed capacity (GWe)	9	70	>100
Share	1.3%	>5%	~10%

China's Action towards Global Nuclear Renaissance

Build an Integrated Fuel Cycle Industry for China's Nuclear Power Program

- **China follows the route from PWRs to FRs for the nuclear fission energy**
- **Closed fuel cycle option is selected as done by France, UK, Russia, Japan and India.**
- **To support the big nuclear energy program, China must build an integrated fuel cycle industry**

China's Action towards Global Nuclear Renaissance

Present status of the fuel cycle in China

- China has built the industrial capability in the **front end** of the nuclear fuel cycle to meet the requirements of the present domestic need of nuclear power.
- The **capability** of the production facilities in the front end of fuel cycle needs **to be expanded** and technologies need **to be upgraded**.
- The **back end** of the fuel cycle in China is a **weak point** and needs to pay more attention for closing the fuel cycle.

Spent Fuel Reprocessing

- The **pilot plant of spent fuel reprocessing** with a capacity of **50 tHM/a** has completed testing with acid and uranium solutions, hot test is being planned.
- R+D work is being done as the technical support to the stable operation of the pilot reprocessing plant.

Spent Fuel Reprocessing

- A **commercial reprocessing plant** is under consideration and is expected to be built by **2025**.
- The plant capacity will be **800tHM/a** with the fuel burnup **45 MWd/kg** .
- This plant will be constructed through international cooperation.

Utilization of Separated Pu

- We believe that the **sustainable** development of nuclear fission energy **depends on the FBR cycle**. China is actively developing FBR technologies, which makes nuclear energy “**renewable**”.
- The separated Pu from reprocessing process will be **recycled in FBRs**. The proposed 1st commercial reprocessing plant could provide separated Pu for the initial requirement of FBR development.
- If FBR is not developed as fast as expected, the separated Pu may be **shared by PWRs and FBRs**.

China's Action towards Global Nuclear Renaissance

HLW Disposal

- The **guideline** of development program for geological disposal of HLW was **issued in 2006**
- The **underground laboratory** is expected to be constructed by **2020**
- The national **geological repository** is hoped to be built by **2060**



Strengthening International Cooperation on Nuclear Fuel Cycle



Strengthening International Cooperation on Nuclear Fuel Cycle

Support the Concept of International Fuel Cycle Centers

- **Closed nuclear fuel cycle** is a **very complicated** system. It takes **long time** with **huge investments** to build such an expensive industrial system.
- Development of the indigenous closed fuel cycle industries for the **countries with small scale** nuclear power will **not be cost-effective** and so unnecessary.
- Spreading of the **sensitive technologies** of nuclear fuel cycle, especially **uranium enrichment** and **spent fuel reprocessing**, may enhance risks of proliferation of **HEU** and **separated Pu**.



Strengthening International Cooperation on Nuclear Fuel Cycle

To cope with this “nuclear dilemma”

- In the global nuclear renaissance, we need to **ensure the non-discriminate and effective access of all countries** equally to the peaceful use of nuclear energy as granted by the NPT.
- Meanwhile, the international **nonproliferation regime** should **be enhanced** so as to lower the risk of nuclear proliferation for securing the world.



Strengthening International Cooperation on Nuclear Fuel Cycle

Concept of International fuel cycle centers

- The concept of international fuel cycle centers was suggested half a century ago.
- This old concept was revisited and accepted by more and more people in the past years.
- Examples reflecting this idea:
 - ☞ **IAEA's multilateral nuclear approaches (MNA) in 2003**
 - ☞ **Russia's President initiative in Jan 2006**
 - ☞ **US initiative (GNEP) in Feb 2006**
 - ☞ **Some other initiatives**



Strengthening International Cooperation on Nuclear Fuel Cycle

Concept of International fuel cycle centers

- **“From cradle to grave”** is a fashionable term in recent years.
- **“From cradle to grave”** means the **ensured service of the whole fuel cycle** including **HLW disposal**, which is **especially attractive to some small countries**, where it is difficult to find the suitable geological formation for HLW disposal.
- **“International repository”** seems technical feasible and economic attractive, but so many non-technical issues are blocking the way ahead.



Strengthening International Cooperation on Nuclear Fuel Cycle

Concept of International fuel cycle centers

- We think that the concept of international nuclear fuel cycle centers has many implications with:
 - ➔ technological feasibility
 - ➔ economical competitiveness
 - ➔ political issues
 - ➔ public acceptance.
- These problems need to be solved gradually through **extensive international dialogues**. The world community is responsible for solving these problems. It's time to start.



Strengthening International Cooperation on Nuclear Fuel Cycle

One world needs only one “ruler” for judging one thing

- Because of the **sensitive nature** of the nuclear fuel cycle, mutual trusts and **confidence-building** among countries is of the first importance for cooperation.
- We need to **set up some commonly accepted principles** or rules for the confidence-building by the member countries under the IAEA framework
- There is only one truth for one thing. **One world needs only one “ruler”**, rather than two or more, **to judge a thing right or wrong**. **To this, IAEA should play more important role.**



Strengthening International Cooperation on Nuclear Fuel Cycle

**The internationalization of nuclear fuel cycle
is a step-by-step process**

- **In the front-end of fuel cycle, we support**
 - ☞ **IAEA initiated “Framework of 3 level arrangement for assurance of nuclear fuel supply”**
 - ☞ **Russia’s “International Center for Enrichment”.**



Strengthening International Cooperation on Nuclear Fuel Cycle

A step-by-step process of internationalization of nuclear fuel cycle

- **In the back-end of fuel cycle,**
 - ☞ we are in favor of the **regional cooperation** on the safe and secured management of **spent fuel** under the IAEA's safeguards
 - ☞ the concept of **spent fuel “take-back”** by, for example, the fuel suppliers may be an **effective expedient** and **attractive to the emerging countries** of nuclear power. The world community needs to discuss this issue seriously.



Strengthening International Cooperation on Nuclear Fuel Cycle

In the immediate future, we think that China could contribute to the following issues:

- **Building more uranium enrichment capacity to support the future needs of other countries;**
- **Joining regional cooperation of spent fuel management;**
- **Providing professional training of personnel from other nations of the region, especially the emerging countries of nuclear power, in nuclear power plant operations, nuclear safety and safeguards and physical security technologies.**



Concluding remarks

We are pleased to see that the IAEA has been making tremendous contributions both to promoting peaceful use of nuclear energy and to strengthening nonproliferation regimes since her founding in 1957. We hope that the IAEA will play more important role in these key areas.

A Chinese idiom says: “both fish and bear paw are delicious but you are not able to taste both of them at one dinner table”. For the nuclear issue, however, we do need both nuclear energy and nonproliferation at “one dinner table”.

I hope that the humankind has sufficient wisdom to solve this nuclear dilemma. And, we are prudently optimistic that with the persevering efforts devoted by all the member countries of the IAEA, the nuclear energy will be developed globally in a safe, safeguarded, secured and sustainable way.



THANK YOU!

谢谢!